Fig. 1

The Topology of Multiple Services Ring

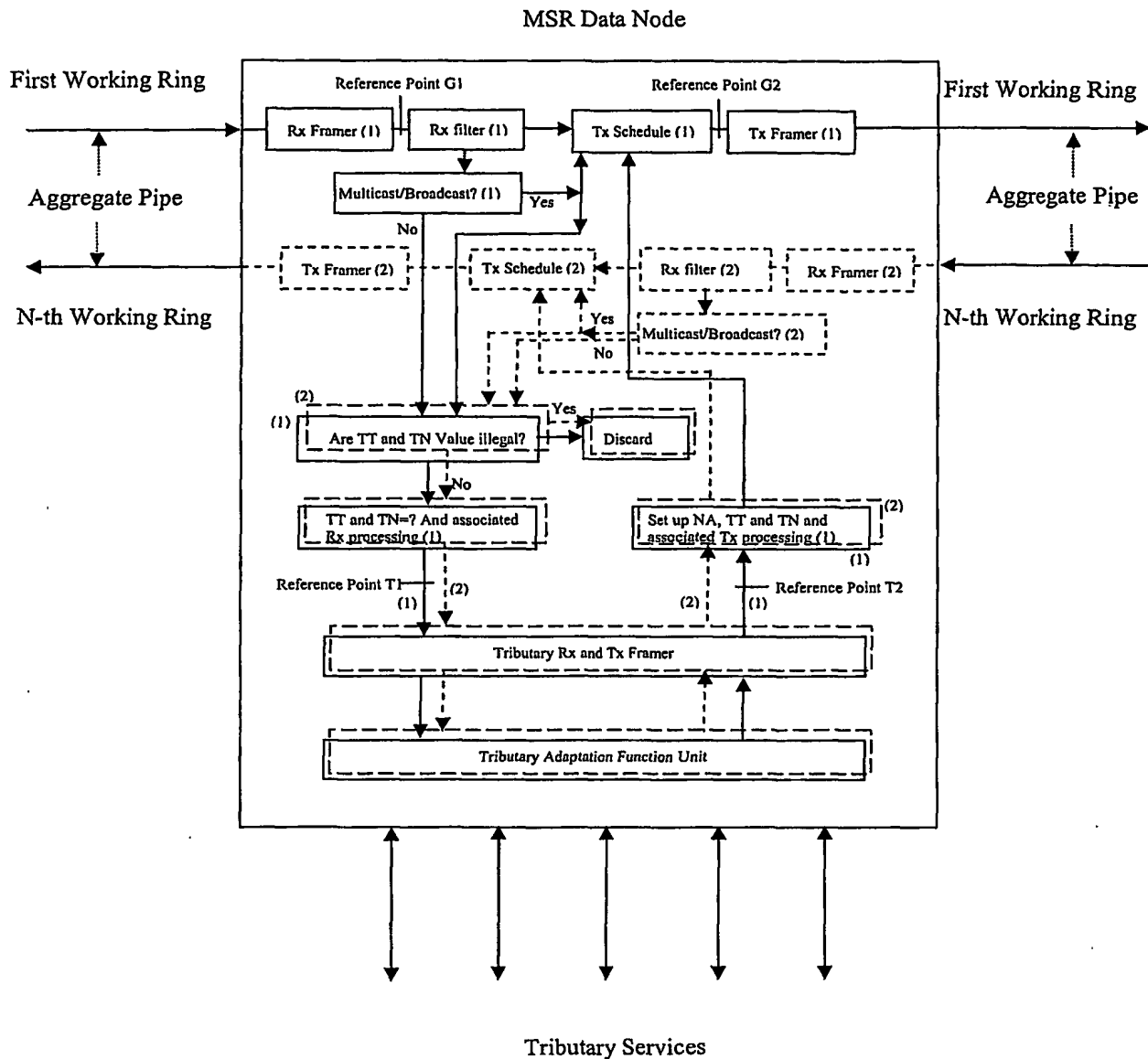MSR Data Node

First Working Ring   First Working Ring

Reference Point G1   Reference Point G2

| Rx Framer (1) | Rx filter (1) | | Tx Schedule (1) | Tx Framer (1) |

Aggregate Pipe   Aggregate Pipe

Multicast/Broadcast? (1)   Yes

No

Tx Framer (2)   Tx Schedule (2)   Rx filter (2)   Rx Framer (2)

N-th Working Ring   N-th Working Ring

Yes

Multicast/Broadcast? (2)

No

(2)

(1)   Are TT and TN Value illegal?   Yes   Discard

No

TT and TN=? And associated Rx processing (1)

Set up NA, TT and TN and associated Tx processing (1)   (2)

(1)

Reference Point T1   (2)   Reference Point T2

(1)   (2)   (1)

Tributary Rx and Tx Framer

Tributary Adaptation Function Unit

Tributary Services

Fig. 2

Tx and Rx Function Diagram of MSR Data Node

DVB   ISDN   G.702   1920Kb/s   CS & NM

L3 packet forwarding

Reference Point T1/T2 ⟶

MSR-LEP frame

Reference Point G1/G2 ⟶

FE/GE/10GE MAC

Fig. 3

Generic Protocol Stack of MSR

Ipv4/Ipv6

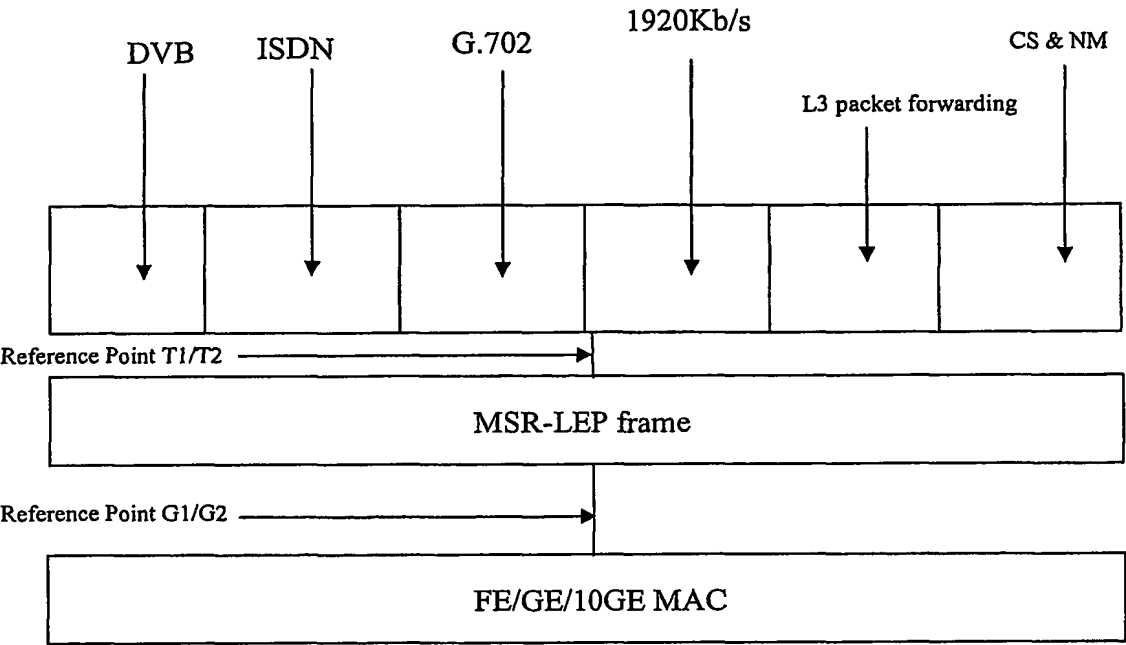Reference Point T1/T2 ⟶
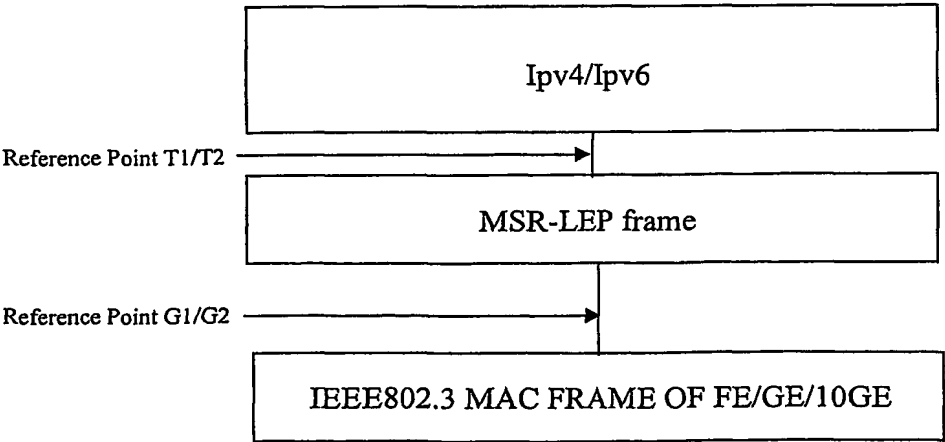
MSR-LEP frame

Reference Point G1/G2 ⟶

IEEE802.3 MAC FRAME OF FE/GE/10GE

Fig. 4

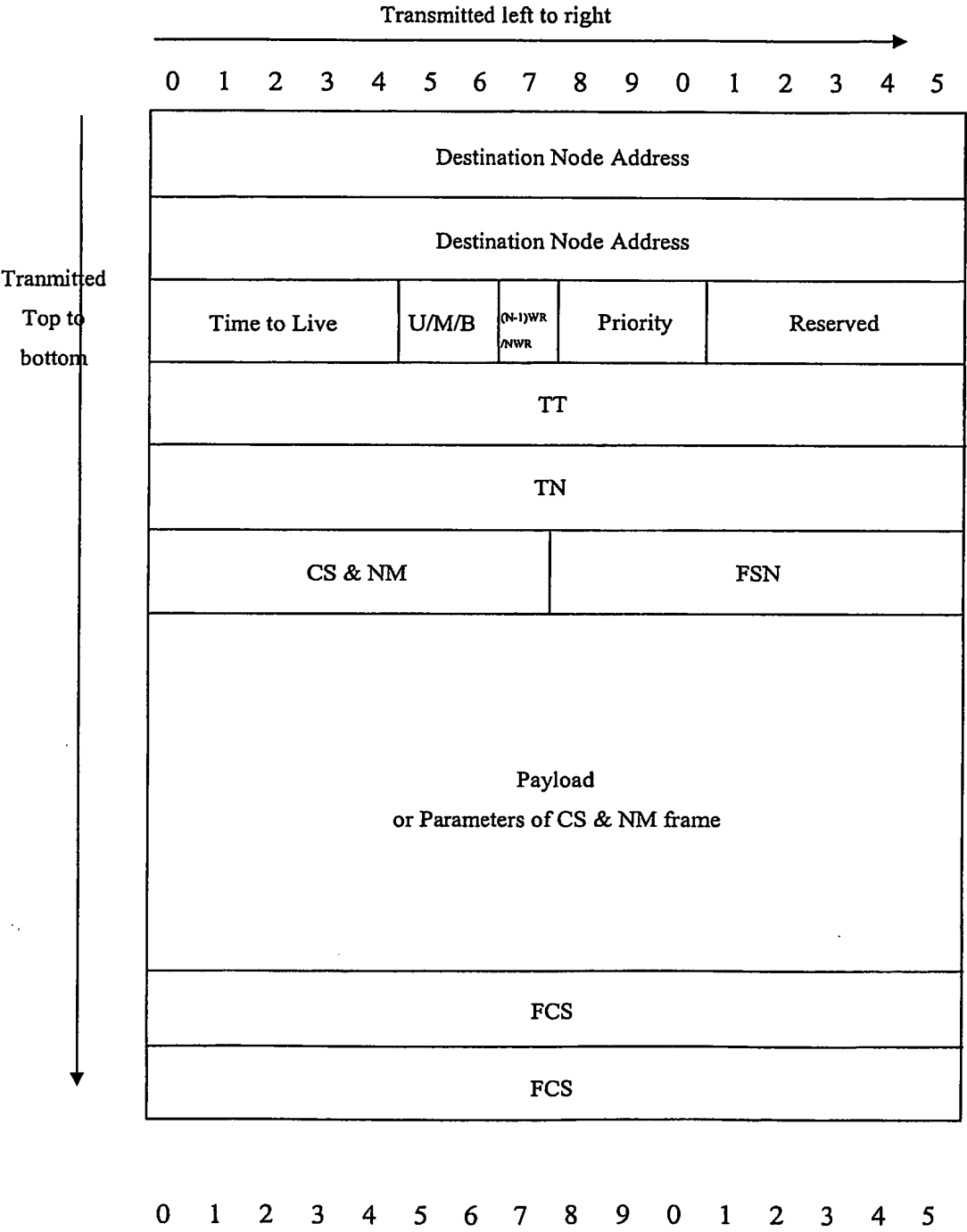**Protocol Stack of IP over LEP in GE and 10GE based Aggregate Pipe, it will be used to Layer 3 forwarding packet**

Transmitted left to right

0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5

Tranmitted
Top to
bottom

| Destination Node Address |
| Destination Node Address |

| Time to Live | U/M/B | (N-1)WR /NWR | Priority | Reserved |

TT

TN

| CS & NM | FSN |

Payload
or Parameters of CS & NM frame

FCS

FCS

0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5

Fig. 5

Generic Frame Format of MSR for the working ring

Transmitted left to right

0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5

| Destination Node Address |
| Destination Node Address |

Transmitted
Top to
bottom

| Time to Live | U/M/B | (N-1)WR /NWR | Priority | Reserved |

| TT |
| TN |
| CS & NM | FSN |
| Source Node Address |
| Source Node Address |
| 4-Octet based Parameters Field |
| FCS |
| FCS |

0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
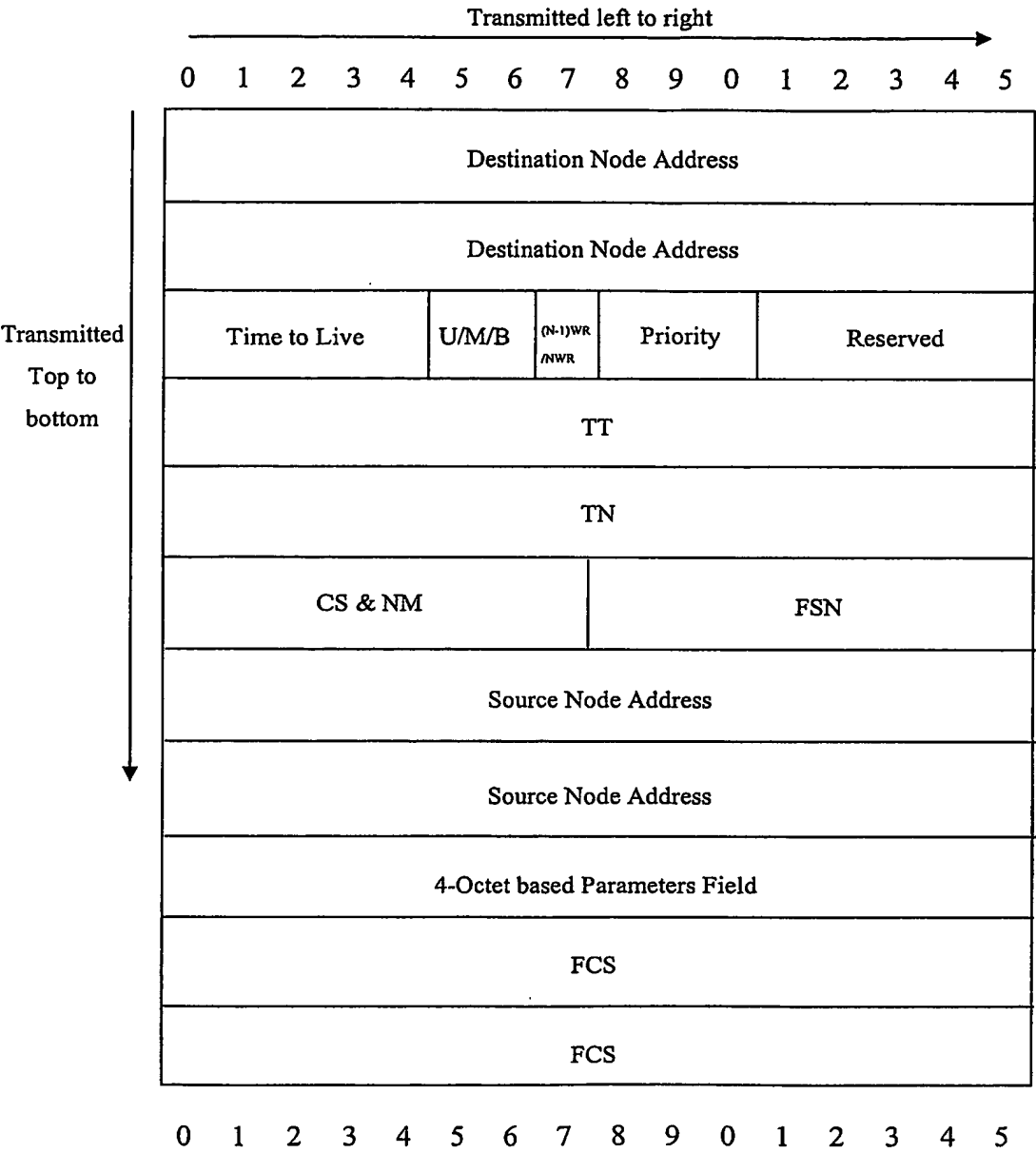
Fig. 6

Generic Format of CS & NM Frames
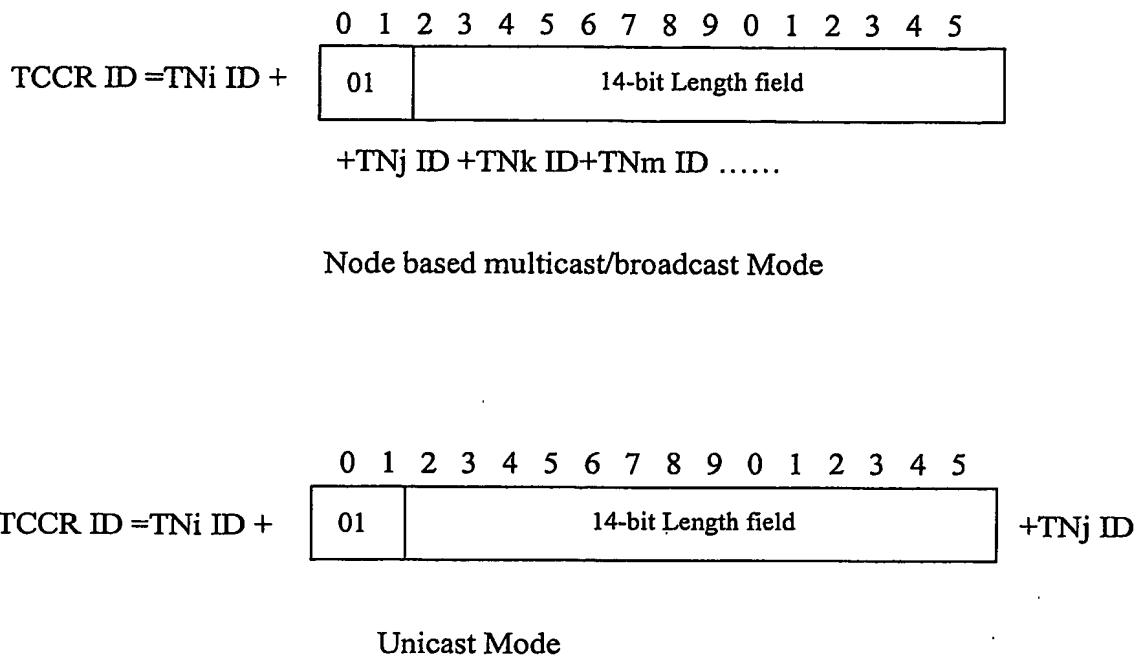
TCCR ID =TNi ID +

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
┌────┬─────────────────────────────┐
│ 01 │      14-bit Length field     │
└────┴─────────────────────────────┘
```

+TNj ID +TNk ID+TNm ID ......

Node based multicast/broadcast Mode

TCCR ID =TNi ID +

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
┌────┬─────────────────────────────┐
│ 01 │      14-bit Length field     │
└────┴─────────────────────────────┘
```
+TNj ID

Unicast Mode

Note: TNi ID=NAx(x=1,2,3...32)+TT+TNp (p=0,1,2,3,...2^{16}-1), to identify the pth Tributary with the fixed TT and TN value within ith node. For the case of Multicast/Broadcast Mode, an tributary based outgoing packet within a source node can be multicast or broadcast to a designated or source tributary (ST) of other sink nodes along a MSR ring or other topologies. Each sink node should have only a source tributary to receive this packet from ringlet at a time. If a membership group of multicast or broadcast has been established within a sink node, the said ST will duplicate this packet to other tributaries with the same membership relation.
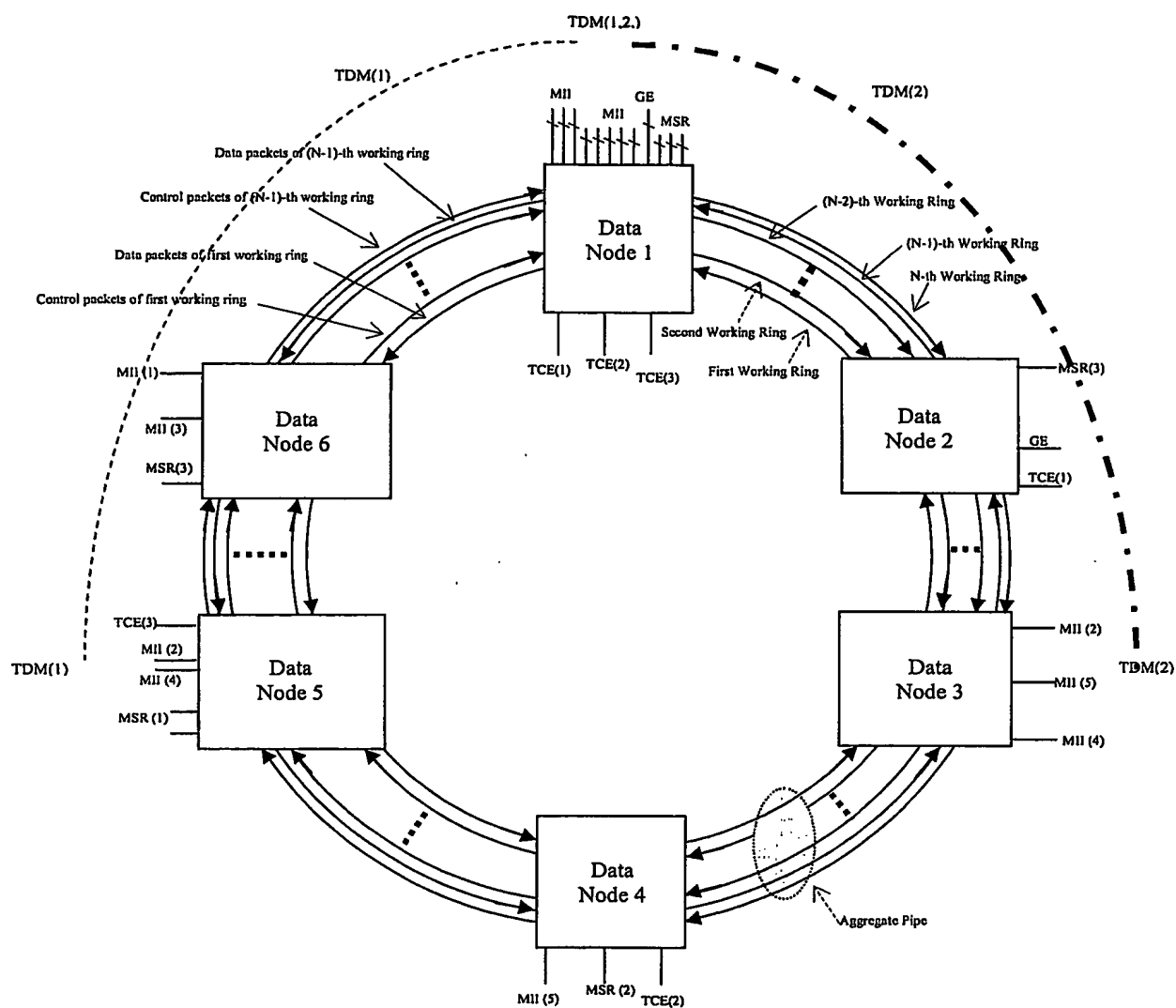
Fig. 7

Expressions of TN ID and TCCR ID
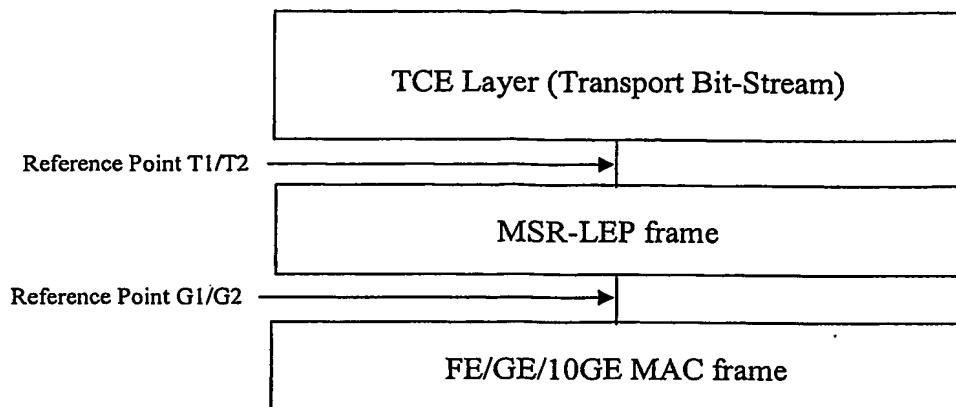
Fig. 8

The TDM Service Channel along MSR

Fig. 9

THE TDM SERVICE CHANNEL OVER BIT FE/GE/10GE

Full duplex point-to-point Mode

Note: TNi ID=NAx(x=1,2,3...32)+TT+TNp (p=0,1,2,3,...2^{16}-1), to identify the pth Tributary with the fixed TT and TN value within xth node. TNi ID and TNj ID stand for standby and working tributary respectively.
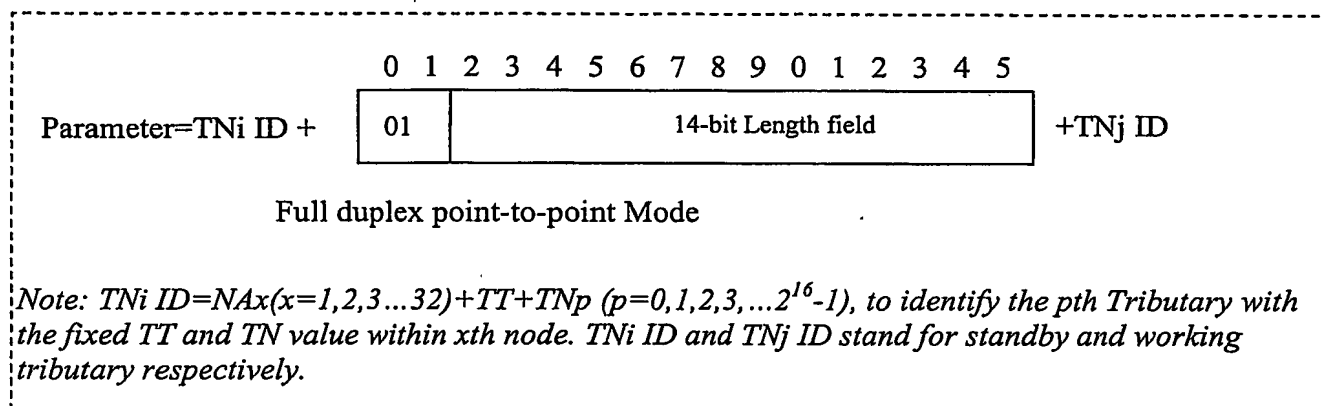
Fig. 10

Expressions of 1+1 and 1:1 tributary protection parameters

+TNj ID +TNk ID + TNm ID +......

Full duplex point-to-point Mode

Note: TNi ID=NAx(x=1,2,3...32)+TT+TNp (p=0,1,2,3,...2^{16}-1), to identify the pth Tributary with the fixed TT and TN value within xth node. TNi ID is used to present standby tributary, and TNi ID, TNk ID and TNm ID etc represent working tributary, the total number is N.
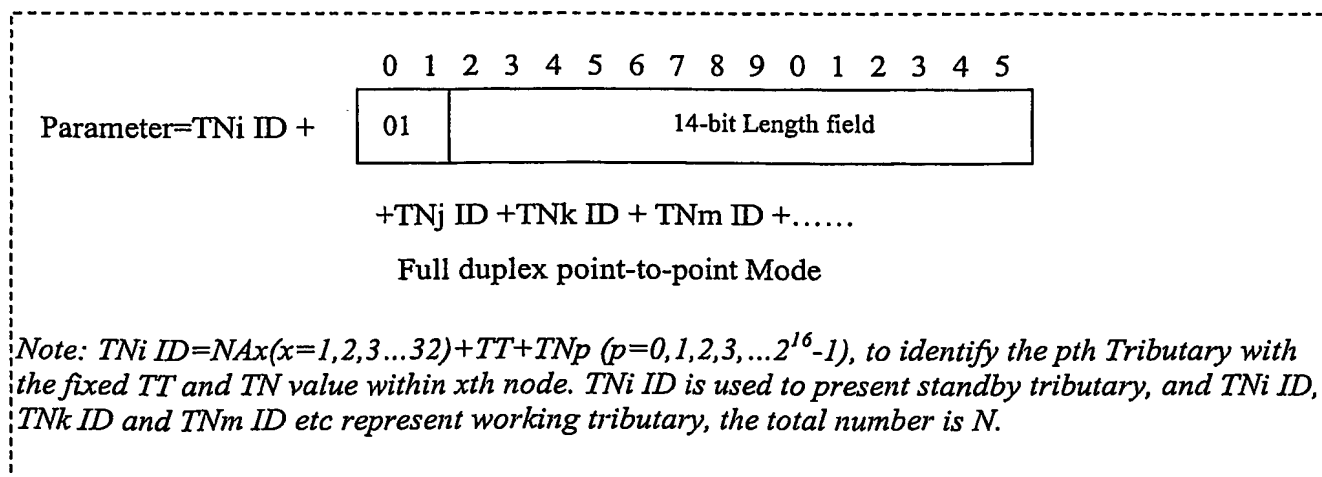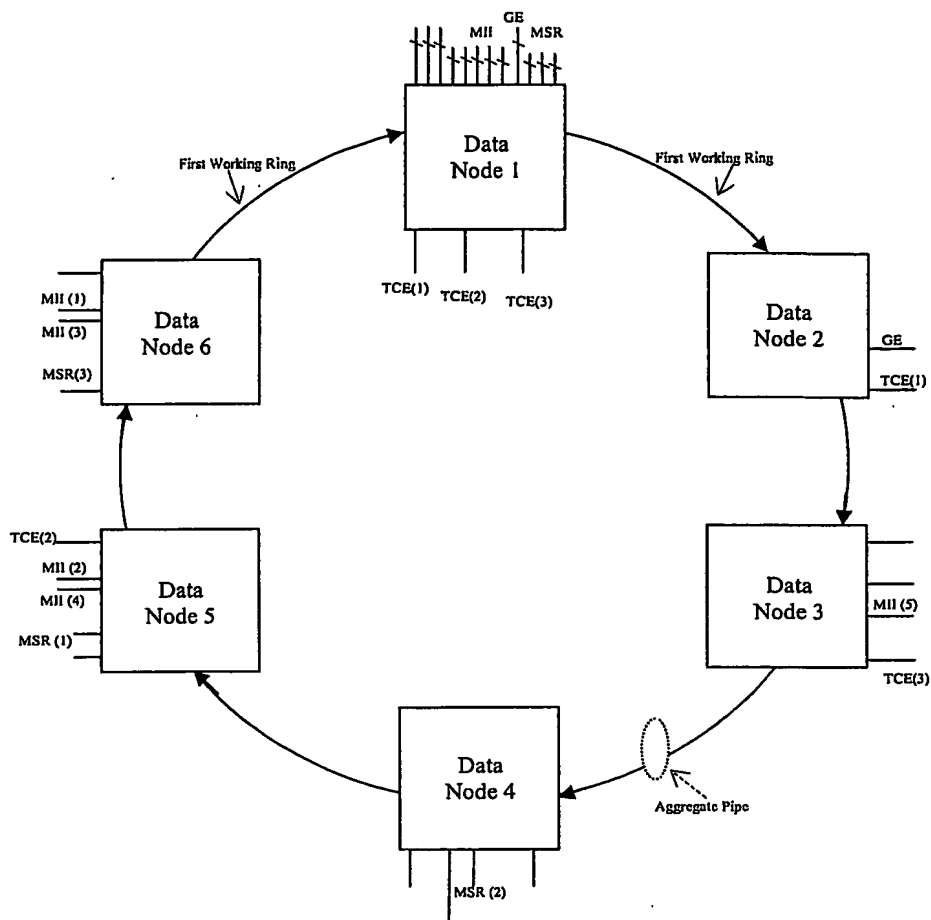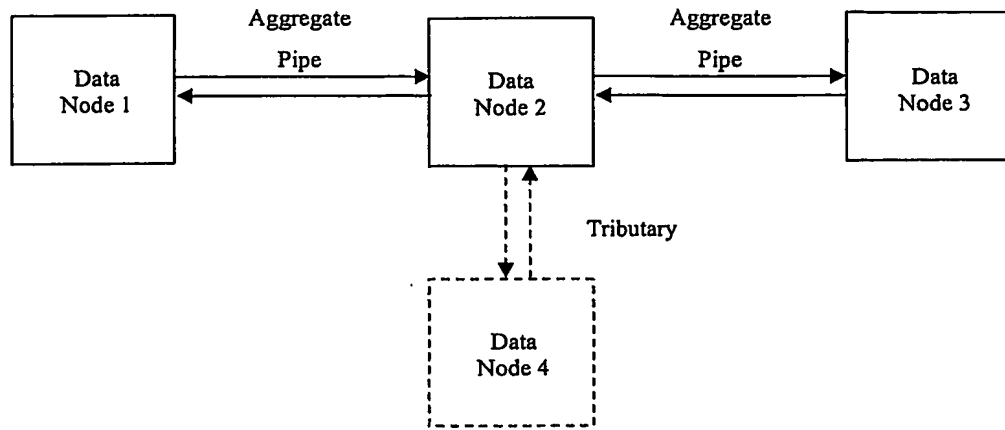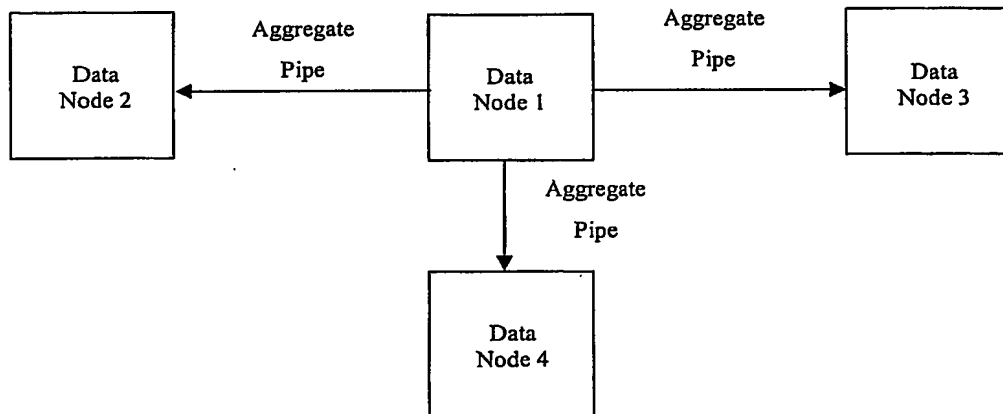
Fig. 11

Expressions of 1:N tributary protection parameter

Fig. 12

The Single Fibre Ring of MSR

Fig. 13

A MSR Topology, Link-type with Adding and Dropping Tributary Services

Fig. 14

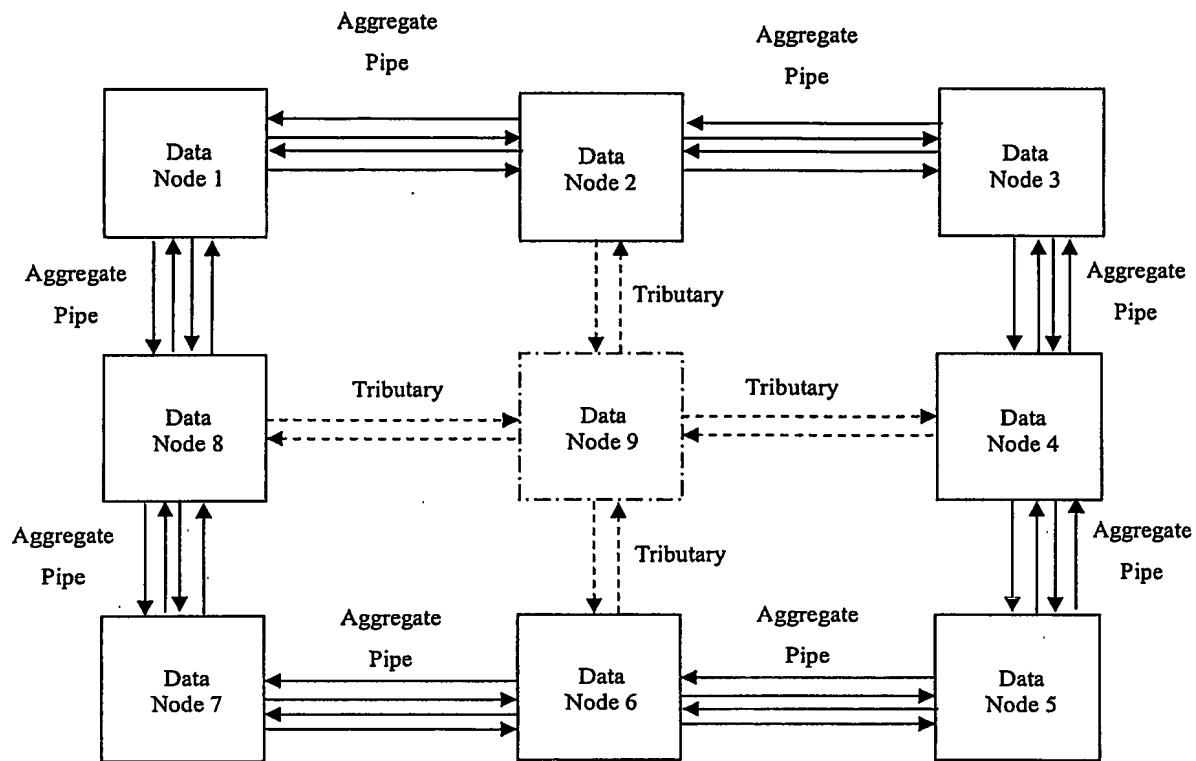**A MSR Topology, Broadcast Connection to DVB Application**
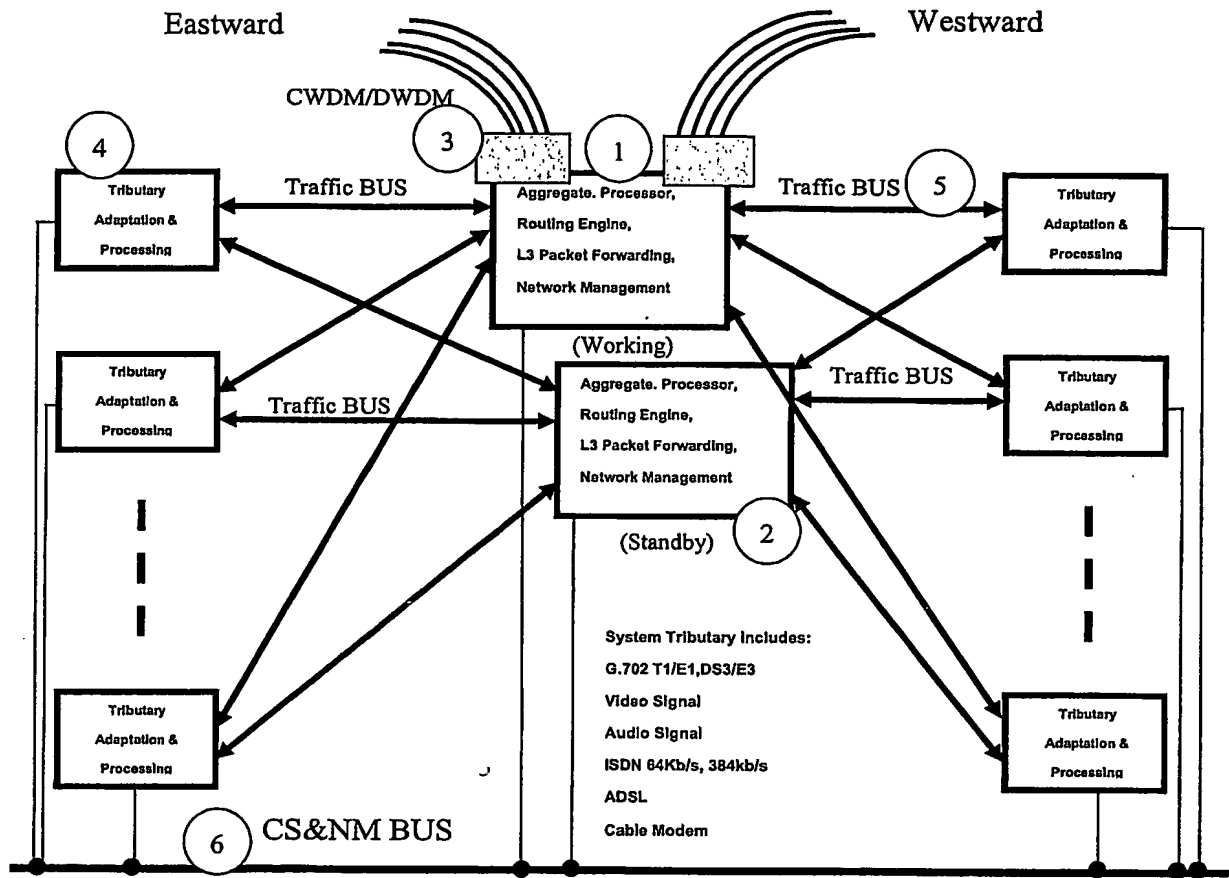
Fig. 15

A MSR Topology, Pseudo-mesh Connection

Eastward   Westward

CWDM/DWDM

(4)
| Tributary Adaptation & Processing |

(3) **(1)** Traffic BUS

Traffic BUS

| Aggregate. Processor, Routing Engine, L3 Packet Forwarding, Network Management |

(5)
| Tributary Adaptation & Processing |

(Working)

| Tributary Adaptation & Processing |

Traffic BUS

| Aggregate. Processor, Routing Engine, L3 Packet Forwarding, Network Management |

Traffic BUS

| Tributary Adaptation & Processing |

(Standby) **(2)**

| Tributary Adaptation & Processing |

System Tributary includes:
G.702 T1/E1,DS3/E3
Video Signal
Audio Signal
ISDN 64Kb/s, 384kb/s
ADSL
Cable Modem

| Tributary Adaptation & Processing |

(6) CS&NM BUS

Fig. 16

The Physical Architecture of a MSR node (Out-of-band CS&NM Bus)

Eastward

Westward

CWDM/DWDM

4 Tributary Adaptation & Processing

Traffic BUS

3 **1** Aggregate. Processor, Routing Engine, L3 Packet Forwarding, Network Management (Working)

Traffic BUS **5** Tributary Adaptation & Processing

Tributary Adaptation & Processing

Traffic BUS

Aggregate. Processor, Routing Engine, L3 Packet Forwarding, Network Management (Standby) **2**

Traffic BUS Tributary Adaptation & Processing

Tributary Adaptation & Processing

System Tributary includes:

G.702 T1/E1,DS3/E3

Video Signal

Audio Signal

ISDN 64Kb/s, 384kb/s

ADSL

Cable Modem

Tributary Adaptation & Processing

Fig. 17

The Physical Architecture of a MSR node (in-band CS&NM Bus)

Aggregate circuit board   Backplane

Network management interface

Tributary circuit board   Tributary circuit board
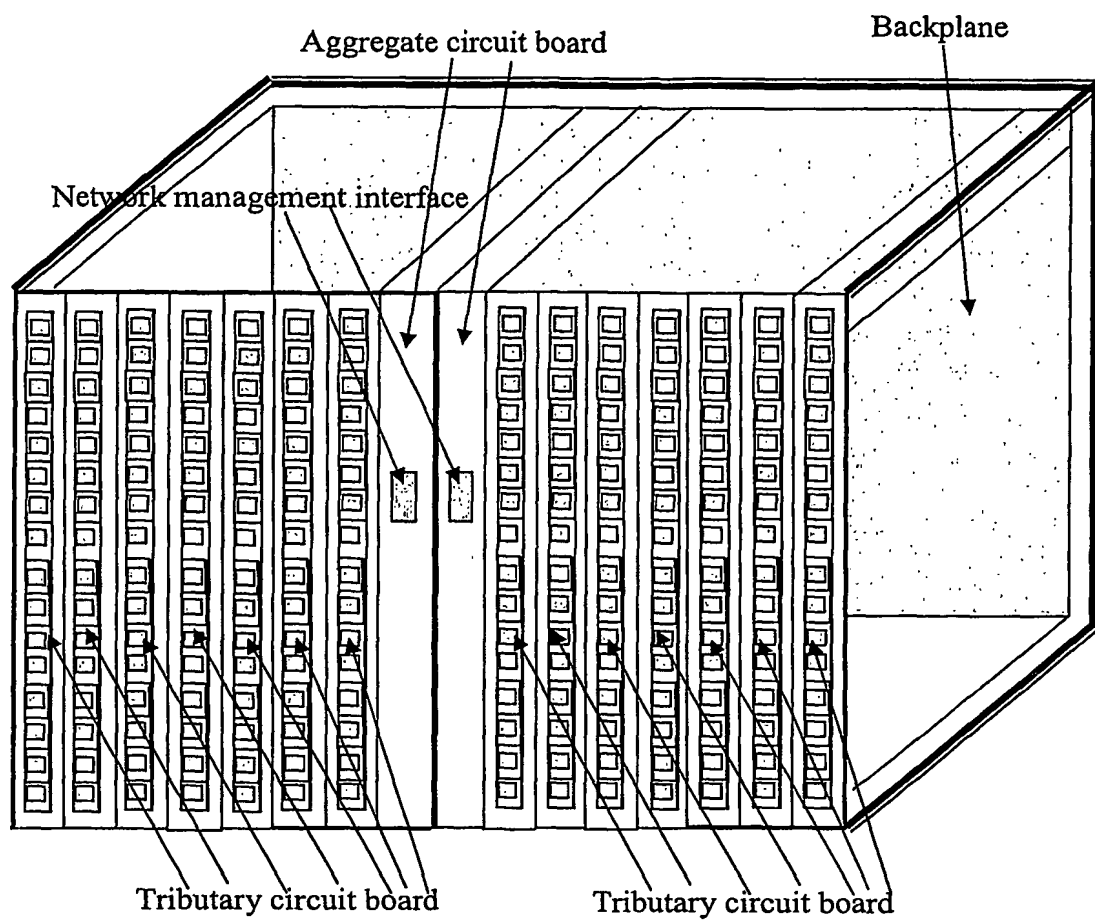
Fig. 18

Layout of system equipment of a MSR node